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TMDL Compliance Approach for the Bunker Hill Mine Water

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Introduction

This memorandum summarizes the approach taken, and the results to date, for developing compliance strategies for the total maximum daily load (TMDL) allocation assigned to the Central Treatment Plant (CTP) which treats the drainage from the Bunker Hill Mine in Kellogg, Idaho.

Approach

The following summarizes the TMDL compliance approach to date:

- A hydrologic comparison of recorded flows from the Kellogg Tunnel (KT) of the Bunker Hill Mine and at the Pinehurst gauge on the South Fork of the Coeur d'Alene river was conducted because the Pinehurst gauge will be used to measure TMDL compliance for the CTP. The allowable monthly average discharge of cadmium, lead, and zinc is dependent on river flow rate.
- Sampling of the current CTP effluent for dissolved metals was initiated. This was done to determine the capability of the existing lime high density sludge treatment process to remove dissolved cadmium, lead, and zinc. Previously only total cadmium, lead, and zinc of the effluent were monitored.
- Additional treatment technologies (sulfide precipitation, iron co-precipitation, and ion exchange) were reviewed and tested in the laboratory for their ability to produce treated water of sufficient quality for TMDL compliance. Emphasis was placed on technologies that could complement the existing lime high density sludge process.
- Source control measures, which could reduce the recharge of surface and groundwater to the mine, were identified with the goal of reducing the amount of flow and pollutant loads requiring treatment.
- A computer model was developed to evaluate compliance with the TMDL assuming different mine water flow rates, treatment plant sizes, effluent concentrations, water management and storage facilities, and river flows.

Results to Date

- The hydrologic evaluation found little correlation between historic mine and river flows on a daily basis. This is likely due in part to the hydrologic differences between the South Fork's large east-west trending watershed and the north-aspect watersheds that overlay the mine, and in part to historic in-mine water management activities. This lack of a correlation necessitated selection of representative annual data sets of KT and river flows for computer modeling.

- Several source control measures have been identified which have potential to reduce both the peak and base flow rates from the mine. These measures may allow for operation of smaller scale treatment equipment.

- The computer model is being used to evaluate sizes of treatment equipment needed depending on the amount of source control that is achieved. The model is also used to evaluate use of pre-treatment storage of mine water for either peak flow reduction or contingency storage in the event of treatment plant shutdown, mine flood, or other unforeseen event.

- The computer model results show that as long as the CTP effluent concentrations of cadmium, lead, and zinc are below certain threshold values, that the TMDL load allocations do not restrict discharges below the design flow of the treatment plant. This reduces the need for large volumes of pre-treatment storage for TMDL compliance.

- Dissolved metals sampling of the CTP effluent indicates that the existing treatment process may be sufficient to achieve compliance with the TMDL with addition of filtration. Average CTP effluent concentrations of dissolved metals collected during treatability sampling are as follows:

  Cadmium: 0.50 µg/L
  Lead: 0.1 µg/L
  Zinc: 18 µg/L

- Laboratory treatability testing has evaluated addition of sulfide precipitation, iron co-precipitation, and ion exchange to the existing lime high density sludge treatment process to further reduce concentrations of dissolved cadmium, lead, and zinc. The addition of soluble sulfide into the lime neutralization process was selected for follow-on testing during the summer of 2000 because it performed as good or better than of the technologies, plus it was considered to be the most cost effective. Dissolved metals were lowered to the following concentrations using sulfide addition during laboratory testing:

  Cadmium: 0.07µg/L
  Lead: < 0.32 µg/L
  Zinc: 15 µg/L

- Filtration of the CTP effluent using either media or micro filters will be needed to reduce suspended metal in the CTP effluent. Both media and micro filtration will be tested during the summer of 2000.